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ORIGINAL ARTICLES.

TABLES WITH DR. BLACK'S PAPER, CONTINUED
FROM LAST NUMBER.

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Name.	Question I.	Question II.	Question III.	Question IV.	Question V.	Question VI.
Kohler, C. H.	Yes	I think so	20/40 in one eye	2 or 3 yrs. after 1 or 26 mos. exam	10%	Yes
Kollock, Chas. W.	Yes if glass not stronger than +2.00	I think so	20/100	6 mos.	5 to 10%	Yes
Krauss, Fred'k	Yes	Yes	5/45	6 mos.	None	Yes
Kress, Palmer J.	Yes	Yes	5/9 one eye, 5/7 other	9 to 12 mos.	—1/2% in rims	Yes
Kyle, John J.	Yes	Yes	20/60	Yearly	?	Yes
LaCrone, O. A.	Yes	Yes	20/70	Yearly	1%	Yes
Lamb, F. W.	Yes	Yes	20/40 or 20/50	6 mos.	—1%	Yes
Lamb, R. S.	Yes	Yes	6/9 one eye, 6/7.5 other	6 mos.	1/2 of 1%	Yes
Lancaster, Walter B.	Yes					
Lapsley, R. M.	Yes	Would require consideration of individual cases		Yearly	1%	Yes
Large, S. H.	Yes	See Remarks		6 mos.	?	Yes
Lauder, Edw.	Yes, conditionally and conservatively *	Yes	See Remarks	Yearly	1/2 of 1%	I certainly can
Leenheer, C. A.	Yes	Yes	20/30	Yearly	1%	Yes
LeFever, C. W.	Yes	Not if gl. give normal V.	No minimum	Yearly	1/5%	Yes
Leicht, Oswald	Yes	Yes	20/30	Yearly	Rare	Yes
Lemere, Henry B.	Yes	Yes	20/40 both eyes	See Remarks	Nil in R.R. work	Yes
Leopold, Isaac	Yes	Yes	6/9	Yearly	1%	Yes
Lewis, J. D.	Yes	Yes	?	Yearly	Very few	
Lewis, G. Griffin	Yes	Yes	20/30	6 mos.	—1/10 of 1%	Yes
Lippincott, J. A.	Yes	Yes		6 mos.	10%	Yes
Lucid, M. M.	Yes	Yes	6/9	3 mos.	2%	Yes
Ludewig, W. H.	Yes	Yes	6/9	6 mos.	1/2%	Yes
Lukens, Chas.	Yes	No		6 to 12 mos.	—1% in rims	Yes
Macleish, A. L.	No experience					
Mahoney, G. W.	I would	Yes	20/40	Yearly	1/2 of 1%	Yes
Manchester, A. E.	See Remarks	See Remarks	See Remarks	See Remarks		
Supt. Motive Power C. M. & St. P. R. R.						
Mann, Wm. A.	Yes	Yes	?	Yearly	1 to 1000 in rims	Yes
Marbourg, E. M.	Yes	Yes	20/50 one eye, 20/40 other	6 mos.	1%	Yes
Marlow, F. W.	Yes	Yes	6/18	Yearly	1%	
Martin, H. H.	Yes	Yes	20/20	Yearly	No idea	Yes
Martin, W. C.	No experience					
Masters, J. L.	Yes	Yes	20/30	Yearly	See Remarks	Yes
May, Chas. H.	Yes	Yes	20/30	3 mos.	Few	Yes
McConachie, A. D.	Yes	No	Any V. brought to normal by gl.	Yearly	*annot guess	Yes
McCoy, Thos. J.	Yes	Yes	20/40	1 or 2 yrs.	1 in 500	Yes
McDavitt, Thos.	Yes	Yes	20/30	Yearly below 50; 2 yrs. above 50	1%	Yes

Don't see how you could fix a standard, as age and different kinds of errors of A. would have to be considered.

Assuming this to mean for fast passenger service, (excluding freight and yard men), I consider a minimum of 20/40 low enough.

I find a large percentage of old enginemen need glasses, and many do wear them when not in danger of being caught. I should go a step farther than you suggest, and permit men with normal V. to wear plain lenses on windy and dust blowing days. How any man can be expected to see when his eyes are constantly streaming tears is beyond me.

Every two years if primary exam. is with cycloplegic. Would suggest that exceptionally strong frames and heavy lenses be used.

Q. 1. That I believe the Railroad Company should continue a man in the line of service in which he is employed,—if on examination or re-examination it is found that his eyesight can be made fully normal so far as strength of V. is concerned and under the other conditions as stated in your inquiry.

Q. 2. I do not think there should be a minimum standard. If the glasses will not bring the eyesight to normal, I would not favor continuing the man in such service.

Q. 3. I would not promote a man into a line of service, such as from fireman to an engineer, on whom it was necessary to put glasses in order to pass the requirements of vision.

Q. 4. From my own personal observations I would say that once a year is sufficiently often for the re-examination, that is where the cause for the re-examination is only the advanced age. After a man has suffered in accident or in severe fit of sickness, it would be well in each case to have such a man examined before they are returned to service, but if the examination is only to take care of the advancing years and the natural depreciation of the eyesight during that time, I believe once a year is as much as is necessary. My personal belief is that a man with properly fitted glasses which bring his eyesight to normal, sees as well, or better, than the man who does not use glasses; his eyes are protected from the wind, and the dust and smoke, and are less liable to run tears from such exposure than the eyes of a man whose eyesight is fully normal, but exposed to the conditions as stated above. The worst trouble is in connection with legal complications. There is a general feeling that a man wearing glasses has not as good general eyesight as one who sees without glasses, and in case of accident lawyers take advantage of every point of this kind and make it embarrassing and sometimes expensive to the company unjustly. The one thing that will overcome this feature will be that conventions of oculists and men who are expert in this calling will take the position that a man's eyesight is as good, or better, when the man is provided with glasses that bring his eyesight to normal, than is a man without them. If this cannot be done, there is always a question of hazard to the company in having men in service who wear glasses.

In examining railroad men have often felt that a grave injustice is done to them in accepting them with a static refraction of such a kind that by the time middle age is reached the visual acuity must fall below the required standard, i. e., cases of a high degree of hypermetropia or hypermetropic astigmatism. Consequently it has seemed to me desirable to take into consideration, not only what the V. is at the time of examination, but also what the static refraction is, and therefore what the V. will be when the man is between 40 and 50 years of age. Unless the use of glasses is unconditionally permitted, this seems to me a very important matter.

If closely corrected and fundus is normal, once in twelve months.

Name.	Question I.	Question II.	Question III.	Question IV.	Question V.	Question VI.
McIntire, Chas.	Yes	Yes				Yes
McKay, R. J.	Yes	Yes	1/3	Yearly		Yes
McKimmie, O. A.	Yes	Yes	5/9	6 mos.	Few	Yes
McReynolds, J. W.	Yes	Yes	Depends on form of ametropia	6 mos.	5% small	Yes
Oculist T. & P. Ry., G. C. & S. F. Ry., Tex. Mid. Ry.					Don't know	Yes
Means, C. S.	Yes	Yes	20/20 one, 20/30 other	6 mos.	-1/10 of 1%	Yes
Merrill, W. H.	Yes	Yes	M. 20/40, H. 20/60	Yearly	1/5 of 1%	Yes
Meyer, J. H. Wm.	Yes	Yes	20/20	6 mos.	5%	Yes
Surg. L. S. & M. S. R. R.						
Miles, Henry S.	Yes	Not if gl. give normal V.		Annually	1/10%	Yes
Miller, H. G.	Yes	Yes	20/40		1/10 of 1%	Yes
Miller, Robt. W.	Yes	Yes	20/25	6 mos.	-10%	Yes, if man is not too old and a bit class engineer
Millikin, B. L.	Yes, if standard is normal V.	Yes	6/6	6 mos.	Very small	Yes
Minor, C. L.	Yes	Yes	20/40	6 mos.	Rare	Yes
Oculist Detroit Southern						
Minor, J. L.	Yes	Yes	20/20	Yearly	Rare	Yes
Mitchell, S.	Yes	Yes	20/40	6 mos.	1/20 of 1%	Yes
Mittendorf, Wm. F.	Yes	Yes	?	Yearly	1%	Yes
Moffett, H. C.	Yes	Yes	20/40	Yearly	-.005	Yes
Montgomery, W. T.	Yes	Yes	20/40	Yearly	1/10 of 1%	Yes
Moore, O. C.	Yes	Yes	6/12	6 mos.	1 to 1000	Yes
Moore, T. W.	Yes	Yes	20/60	Yearly	2%	Yes
Moraweck, E.	Yes	Yes	20/40	6 to 12 mos.	-5%	Yes
Morrison, Frank A.	Yes	Yes	10/20	Yearly	Rare	Yes
Morrow, Ed. P.	Yes	Yes	20/100	Yearly	Almost none	Yes
Moss, R. E.	Yes	Yes	20/50	6 mos.	1%	Yes
Mott, J. S.	Yes	Yes	20/30	Yearly	2%	Yes
Moulton, H.	Yes	Yes	1/4	Yearly	5/10%	Yes
Muncaster, S. B.	Yes	Yes	6/9 or 6/12 and 6/6	6 mos.	5%	Yes
Munson, G. S.	Yes	Yes	20/40 and 20/50	6 mos.	Rare	Yes
Murphy, F. G.	Yes	Yes	20/20 and 20/30	3 mos.	-1%	Yes
Norton, C. E.	Yes	Yes	20/30	4 mos.	5%	Yes
Noyes, G. L.	Yes	Yes	?	6 mos.	Rare	Yes, fully
Oldham, J. Y.	Yes	See Remarks	See Remarks	6 mos.	Rare	Yes
Owens, John E.	See Remarks					
Chief Surg. C. & N. W. R. R.						
Park, J. Walter	Yes	Yes	20/200	6 mos.	Very rare	Yes
Parker, E. F.	Yes	Yes	?	Yearly	1%	Yes
Patterson, J. A.	Yes	Yes	6/9	Yearly	-1/10%	Yes
Oculist Col. Mid. Ry.						
Patterson, J. M.	Yes	No		Yearly	-1/10 of 1%	Yes
Patterson, M. F.	Yes	Yes	20/50	6 mos.	1/5%	Yes
Patton, Chas.	See Remarks	Yes	20/30	6 mos. to 1 yr.	1%	See Remarks
Payne, C. W.	Yes	Yes	20/60	Yearly	-1%	Yes
Payne, C. S.	Yes	No—Remarks		6 mos.	1/2 of 1%	Yes
Payne, S. M.	Yes	Yes	20/20	6 mos.	-1 in 1000	Yes
Pearson, Wm. W.	Yes	Yes	20/40	Yearly	?	Yes
Peck, W. H.	Yes	No	Unimportant if gl. give normal V.	Yearly	-1%	Yes
Pfingst, Adolph O.	Yes	No	See Remarks	3 to 4 yrs.	?	Yes
Peters, W. H.	Yes	Yes	20/100	6 mos.	10%	Yes
Petermann, H. E.	Yes	Yes	20/20 and 20/40	6 mos.	Very small	Yes
Pinckard, C. P.	Yes	No	None	6 mos.	1/10%	Yes
Pischel, Kaspar	No experience					
Plummer, S. C.	See Remarks					
Chief Surg. Rock Is. Sys.						
Pooley, Thos. R.	Yes	Yes	20/30	5 yrs.	?	Yes

Question VI.

Remarks.

For new men my opinion is that normal vision for both eyes should be required.

If there are any signs of approaching cataract examine every 6 mos.

While vision may be defective, the engineman may be very expert and skillful. That would more than balance; otherwise should be retired.

So long as his vision can be brought to normal with glasses I would consider him a safe man.

Firemen and brakemen are not eligible for promotion when glasses are required to reach the standard normal vision, and under such circumstances, they are not retained in service; they are given a certain specified time in order to get other employment. Many special examinations of men in the service are made, and in order to be retained, the employe must have 20/30 V. in each eye, or 20/20 in one and 20/40 in the other without glasses, or he may be retained if glasses will bring his visual acuity to this point. There is considerable difference of opinion as to whether men should be examined every three or five years. There are some men in our service who are examined every year. I think that 3 years would be a good average.

I have always advocated that it is not right to discharge a man on account of his diminution of distant vision when he can have normal vision with glasses, but compel him to carry an extra pair or two along.

Remarks

If muscular balance is good and patient's manifest is not less than 20/30 and lens give a vision of 20/15. Some railroads I think very careless as to vision of employes, and that only a vision with 20/20 each eye, singly, and 20/15 with both eyes should be considered.

No standard; if glasses bring vision up to normal is all that is necessary.

I have contended for years that a great injustice has been done employes by not permitting the use of glasses by officials who were themselves wearing gl. However, I always advise flagmen at crossing should not wear glasses, but should have perfect vision without, so they can see to the side as well as in front, and also prevent danger from snow, rain, or sleet getting on the glasses. It is a very common trick for railways to hire old, decrepit, half-blind cripples to guard crossings, because they have to take care of disabled employes. It is a case of the blind leading the blind. Men in such a position ought to have all their faculties perfect.

As long as normal vision with glasses, amount of refractive error should not prevent promotion.

I do not feel competent to answer the questions which you ask in your circular, as I have had no practical experience as to the effect on glasses of being in an engine cab, whether the vision becomes blurred by condensation of vapor or by coal smoke or not. I would value your opinion in this direction very highly, because you have probably had more experience in this line than any other ophthalmologist. I am interested to know that you think a man with glasses is a safe employe, because it seems very hard to discharge experienced employes as soon as their vision requires their wearing glasses. In answer to your 2nd question, I would answer yes.

Name.	Question I.	Question II.	Question III.	Question IV.	Question V.	Question VI.
Posey, W. C.	No experience					
Post, M. H.	Yes			Yearly	Almost never	Yes
Prichard, J. M.	Yes	Yes	20/30	6 mos.	10%	Yes
Prefontaine, L. S.	Yes	Yes	20/20 and 20/30	Yearly	Very small	Yes
Pritchard, J. F.	Yes	Yes	20/20 and 20/30	Yearly	See Remarks	Yes
Chief. Surg. Wis. Cen. R. R.						
Prout, J. S.	Yes	Yes	?	?	-1/10%	Yes
Pusey, Brown	Yes					Yes
Pyfer, H. F.	Yes	Yes	6/60	Yearly	1/100%	Yes
Quackenboss, Alex.	Yes	Yes	?	Yearly	Rare	Yes
Quayle, R.	Yes	Yes		Yearly	No idea	Yes
Supt. M.P.C. & N.W.R.R.						
Randall, B. Alex.	Yes	Yes	1/3	6 mos.	1:10,000	Yes
Randolph, R. L.	Yes	Yes	20/40 and 20/30	2 yrs.	5%	Yes
Raub, J. F.	Yes	Yes	20/40	Yearly	-1%	Yes
Ray, J. M.	Yes	Yes	See Remarks	6 mos. to 1 yr.	Very few	
Oculist L. & N. R. R.						
Reamer, E. Frank	Yes	No	20/50	6 mos.	-1%	Yes
Reese, R. G.	Yes	Yes	20/30	Yearly	1/10 of 1%	Yes
Remmen, N.	Yes	Yes	20/40	2 or 3 yrs.	1 in 5000	Yes
Reynolds, Dudley S.	Yes	Yes	6/18	Yearly	1/100%	Yes
Reynolds, J. W.	Yes	Yes	20/50 and 20/30	6 mos.	1/5%	Yes
Ritchie, Stephen O.	Yes	20/20	20/20	6 mos.	Rare	Yes
Ridout, W. J.	Yes	Yes	20/60	6 mos.	1/10 of 1%	Yes
Rinehart, H. W.	Yes	See Remarks	20/40	12 mos.	1/4%	I can
Risley, Sam'l D.	Yes	Yes	6/9	Yearly	Rare	Yes
Roberts, W. H.	Yes	Yes	6/12	Yearly		Yes
Robin, E. A.	Yes	Yes	20/40	Yearly	Rare	Yes
Rodman, C. S.		Yes	See Remarks		?	Yes
Rogers, A. C.	Yes	Yes	20/70	Yearly	1/500	Yes
Rogers, Benj. F.	Yes, +1 D.	Yes	20/30 +1 D.	4 to 6 mos.	1%	Yes
Rogers, W. K.	Generally speaking, yes, but personal equation must be counted and a minimum of such eyes should be reached by excluding latent hyperopes, etc.	Yes	An arbitrary standard should be adopted by trunk lines through mutual agreement on recommendation of expert committees	About once in two years if full correction is worn and accidents are treated by company surgeons except myopes	The number is too small to estimate	Yes, with the qualifications added to Questions 1 and 4
Rohrer, Geo. R.	Yes			6 mos.	Small	Yes
Roller, Louis A.	Yes	Yes	20/40	Yearly	-1/2 of 1%	Yes
Roy, Dunbar	Yes	Not arbitrarily fixed	Should vary with individual case	Yearly	?	Yes
Rudgers, D. W.	Yes	Yes	20/40	6 mos to 1 yr.	Very small	Yes
Russell, E. R.	Yes	Yes	20/50	6 mos.	-3%	Yes
Ryan, E. S.	Yes	No	See Remarks	6 mos.	Rare	Yes
Ryan, L. R.	Yes	Yes	20/70	Yearly	1%	Yes
St. John, S. B.	Yes	Yes	20/40	3 yrs.	3 in 20,000	Yes
Sampson, F. E.	Yes	Yes	20/40	See Remarks	-1%	Yes
Samson, W. Stanley	Yes	Yes	20/20	6 mos.	5%	Yes
Sanders, A. F.	Yes	Yes	7/10	Yearly]	Very few	Yes
Savage, G. C.	No experience					
Schaefer, Otto	Yes	No		Depends on condition	Very small	Yes
Schild, Edwin H.	Yes	Yes	20/40	Yearly	Very small	Yes
Schweinitz, de, George E.	Yes	The standard should not be below 6/6 or 6/9		Yearly	Rare	Yes

Question VI.

Remarks.

From my knowledge of refraction and my own experience (H. 1.75+.50, 90° V. 20/12 either) in driving, bicycling, and driving an automobile (I am almost 54), I am very positive in my opinion that I should answer yes to your 1st question. I did not require glasses for any purpose until I was 40, and I do all above mentioned things with bifocal glasses.

Our standard is 20/20 with both eyes for all men coming into the service, and approximately that when glasses are required. Anything less debars them from train service. In cases of doubt, which happens only occasionally, there is change made in occupation. Two pairs of glasses are required in case of accident. He is still likely to be provided. All diseased conditions debar him from service.

Depending on his age; if over 45, 20/50; if under 45, 20/30.

Yes and no. Consistent with Question 1, and vision brought to 20/20, then no.

R. R. Cos. should pay for expert advice and make their rules.

In general terms our plan on this division (S. W. System of the Penna. R. R.) has been to retain old employees, that is, the class which you describe, who have been at least five years in service, provided their acuity conforms to the required standard by aid of glasses. In this connection, however, it should be borne in mind that the policy in accepting new employees is to require practically normal vision, without glasses, which in the course of time must nearly eliminate defective acuteness in the older employees, excepting in those where the well marked latent hypermetropic error exists, and even some of these may be eliminated during preliminary examination. Without this feature, I am not sure that I would consider it a safe rule to retain even old employees unless of exceptional character and experience whose visual minimum was low. Again, the position of the employee must be considered; an engine driver has need of visual maximum much in excess of any other operative on the train, and where promotion has this position in view a higher standard should be required than for other places. It is, I think, a distinct disadvantage for a man in this position to be required to wear glasses, and I am reasonably satisfied that they possess an average working acuteness without glasses which is more serviceable with vision of 6/10 to 6/13 than with glasses which would in a consultation room give vision of 6/6. Furthermore, while the minimum standard is advisable in general terms, the personal equation, as I have mentioned under Question 1, must account for a great deal. An engine driver of 15 or 20 years of experience is usually a much safer man with a considerable error of refraction, corrected by glasses giving from 6/10 to 6/6 vision, with all their disadvantages, than one of 4 or 5 years of service. A man who is tried out and is known to possess grit, discretion and presence of mind cannot be readily classified, and while the surgeon adhering to the letter of a fixed standard would be obliged to report adversely upon his visual qualifications, his personal characteristics are too rare to allow this to be an arbitrary bar to his employment. Regarding the minimum standard of vision to be allowed, it seems to me that, as I have said in answer to the Question, it can only be established by a more or less arbitrary decision, which I should think could best be reached by the Railroad authorities themselves,—the various Trunk lines acting in conjunction,—upon the recommendation made by a committee or committees, to be made up of their various oculists.

No limit necessary if vision can be brought up to normal.

The only danger I see in such cases is the possibility of the glasses becoming covered with oil or steam, and the vision blurred in consequence of it. In cold weather on entering the cab the glasses will invariably become steamed.

Depending on patient's age, cause of defect, the time would vary. The 6 mos. period is good as a conventional period.

I am very much of the opinion that employees should be allowed to use glasses when it is necessary under the conditions which you describe. It would be very absurd if they were ruled out. Commandants of battle ships, officers in all of the civilized armies of the world, and officers on Trans-Atlantic liners,

Name.	Question I.	Question II.	Question III.	Question IV.	Question V.	Question VI.
Schutz, M. H.	Yes	Yes	10/50	Yearly	1/2 of 1%	Emphatically
Schwenk, P. N. K.	Yes	Yes	2/3	Yearly	-1%	Yes
Seabrook, H. H.	Yes, unless V. is below 20/50	Yes	20/50	6 mos.	-1%	Yes
Seaman, G. E.	Yes	Yes	20/50	6 mos.	Rare	Yes
Sells, F. W.	Yes	Yes	6/6 with gl.	6 mos.	2%	Yes
Shaw, H. L.	No experience					
Shorten, J. H.	Yes	Yes	20/30	4 mos.	-1%	Yes
Skeel, Frank D.	Yes	Yes	20/40	6 mos.	-1%	Yes
Smith, F. A.	Yes	Yes	20/100	2 yrs.	None	Yes
Smith, F. K.	Yes	Yes	?	Yearly	1 in 5000	Yes
Snell, Simeon	Yes	Yes	?	6 mos. to 1 yr.	Very small	Yes
Snyder, Walter H. Oculist Wabash Ry.	Yes, I know men who wear them for protection from dirt, cinders, etc.	Yes, but it must be carefully stated	I suggest only one eye must be 20/50, other not less than 20/80	Every yr., at no expense to the employee	1/2% or less; very small number	Yes, but experience might cause me to verify it more fully
Spalding, F. M.	Yes	Yes	20/20	6 mos.	Very small	Yes
Spalding, Jas. A.	Yes	Yes	20/50	6 mos.	None	Yes
Spencer, J. H.	Yes	Yes	20/30	3 mos.	Almost nil	Yes
Spohn, Geo. W.	Yes	Yes	20/30	Yearly	1%	Yes
Starr, Elmer G.	Yes	Yes	20/40	1 1/2 yrs.		Yes
Standish, Myles	Yes			Yearly	Rare	Yes
Starkey, Horace M.	Yes	No fixed rule	No fixed rule	Yearly	Rare	Yes
Steele, Henry D.	Yes	Yes	20/40 - 20/50	6 mos.	Rare	Yes
Stevens, C. L.	Yes	Yes	20/30		Rare	Yes
Stevenson, Mark D.	Yes	Yes	1/3	6 to 12 mo.	-1%	Yes
Stevenson Bros.	Yes	Not if gl. correct V.	With 2 pr. gl., let it be ever so great	6 mos.	2%	Yes
Stillson, Hamilton	Yes				1/10%	Yes
Stockwell, C. D.	Yes	Yes	6/12	6 mos.	1/2 of 1%	Yes
Strawbridge, Geo.	Yes	Yes	2/3	Yearly		Yes
Stuart, C. C.	Yes	Yes	6/12	6 mos. - glasses seen oftener	-1%	Yes
Stucky, J. A.	Yes	Yes	20/30	Yearly	1/4%	Yes
Stueber, F. G.	See Remarks	By all means	20/30	6 to 12 mos.	Seldom	I can
Stricker, Louis	Yes	Yes	6/9	6 to 12 mos.	10%	Yes
Sturdevant, J. R.	Yes	Yes	15/20	6 to 12 mos.	1%	I can
Suker, Geo. A.	Yes	Yes	See Remarks	6 to 9 mos.	Rare	Yes
Sutphen, T. Y.	Yes		20/20 binoc.	12 mos.	?	
Swan, C. J.	Yes	Yes	20/40 to 20/50	Yearly	15 of 1%	Yes
Taylor, L. H.	Yes	See Remarks	See Remarks	Yearly	Rare	Yes
Tiffany, Flavel B.	Yes	Yes	20/40	4 mos.	1/10 of 1%	Yes
Thomas, Chas M.	Yes	No		6 mos.	1 - 1000	Yes
Thomson, Edgar S.	Yes	Yes	20/100	6 mos.	1%	Yes
Thompson, E. H.	Yes	Yes	20/200	Yearly	10%	Yes

Question VI.

Remarks.

all use glasses when it is necessary. The question in regard to the minimum standard of diminution of vision are more difficult to answer. Personally, it seems to me that glasses, if worn, should always give the patient at least 20/20 in one eye and 20/30 in the other, as tested in the room of the ophthalmic surgeon or examiner, because I need not point out to you that glasses which give a visual acuity of 20/20 in a room do not give an equivalent visual acuity of 20/20 when used at very long ranges, particularly under certain climatic conditions, and therefore the standard should not be allowed to fall much below the 20/20 test. Perhaps it would be better not to have any minimum standard of diminution, but patients be required to have full visual acuity, either with or without glasses. It seems to me there is a good deal of value in Oliver's suggestion that a good many of these tests ought to be made at very long ranges with suitable enlargement of the test objects. I think, however, that what you have said in regard to increasing the value of the employee, by increasing his visual power with glasses, is certainly important.

Amber glass not only cuts off the chemical rays, but the ultra violet rays as well. There is no doubt about the increase in vision, although I have found no difference by the test types with corrected refraction. It has been claimed for amber yellow shooting glasses that is vision is better in fog or rain. Golden yellow shooting glasses are used in India, especially for twilight shooting, and were suggested year before last in England for night blindness. Personally I have not found such effects, although yellow cuts off less light rays than any other glass. Gall and Lembke handed me an anti-sweat (Lacin) pencil a while ago which protects glasses from moisture. With corrections in yellow, and such protection from wet, it would seem as though certain valuable engineers might be saved to the railroad service.

but experi-
might cause
to verify it
e fully

It is practically IMPOSSIBLE to get a great number of engineers who have perfect vision at the age they usually are when they get fast runs, and we prefer to have an oculist fit them to an optician. With the good offices of Dr. Wm. Thompson I put a man back whom the Supt. thought hardly safe. These superintendents do not recognize how few engineers have emmetropic eyes, although they see 20/20, but they have astigmatism and hyperopia, and I prefer to ride behind one of my engineers with 20/20 and a carefully fitted pair of glasses, than a man with the same error uncorrected and straining his eyes with a pair of some optician's glasses. We re-examine a man when he is reported as having run by a signal. Last year I suggested at our annual surgeons' meeting a re-examination of all our men before the Fair at St. Louis. This was done and not an accident was caused by poor eyesight. Engineers on fast runs should be examined every year at the longest, I think.

All lenses are liable to blur in frosty weather from change of temperature; opening of furnace door will occasionally throw out hot air, which will condense on spectacles of engineers for a short time. If the wearers are careful about this, as well as about leaving engine and going into the warm station rooms, I see no risk in their wearing spectacles for the hypermetropia or astigmatism of advancing years.

While not desirable, ought to be continued in service. Just wish to cite the case of an engineer, whose V. without glasses is very low, with glasses about 20/30, yet he has told me that he rarely uses the glasses and does not like to wear them. I enquired, "How does it happen that you having a fast run, have never had trouble?" "Am exceedingly cautious, watch the time, etc." Certainly this man is of more than ordinary intelligence, excellent judgment, sober in the fullest sense, has been my patient for years, yet the facts are as stated.

It has always seems to me to be a great injustice to turn a man down simply because his accommodation needs supplementing. I would further say that, at least 00 eye in rims should be used, 000 better, and in presbyopes the depressed bifocals should be designated as reducing confusion to a minimum.

If vision in either eye can be brought up to 6/7, it matters not what his vision is without glasses. Vision of 6/15, with or without glasses, should debar promotion of any kind.

Not if glasses raises vision to the required standard. No matter what the vision if glasses bring it to the standard, I should regard him safe.

Name.	Question I.	Question II.	Question III.	Question IV.	Question V.	Question VI.
Thompson, J. L.	Yes		20/50	Yearly		Yes
Thorington, Jas.	Yes	No		6 mos. to 2 yrs.	1%	Yes
Todd, Frank C.	Yes	Yes		Yearly	1 in 2000	Yes
Valk, Francis	Yes	Yes	20/20	Yearly	Very small	Yes
Van Benschoten, G. W.	Yes	Yes	20/40	Yearly	5/10 of 1%	Yes
Veasey, C. A.	Not if V. less than 20/30	Yes	20/20—no gl. should be permitted	4 to 6 mos.	?	See Remarks
Voorhies, A. H.	Yes	Yes	1/3	Yearly	—1/10 of 1%	Yes
Voorhees, Sherman	Yes	Yes	20/30	Yearly	10%	Yes
Wadsworth, O. T.	Yes	Yes		6 mos.	Very few	Yes
Waite, F. L.	Yes	Yes	20/100	2 yrs.	Very small	Yes
Warfield, Clarence	Yes	Yes	20/40	Yearly	1%	Yes
Oculist I. G. A. R. R.						
Warren, J. N.	Yes	Yes		6 mos.	Rare	Yes
Railroad Surgeon						
Webster, David	Yes	Yes	20/40	6 mos.	1 in 1000	Yes
Weeks, J. E.	Yes	No		Yearly	1/10%	Yes
Wells, David W.	Yes	Yes	1/10	6 mos.	1%	Yes
Welsh, D. Emmett	Yes	Yes	6/6 and 2/3	Yearly	1/4 of 1%	Yes
Wescott, Cassius	Yes	Yes	6/15	Yearly	Very small	Yes
White, J. A.	Yes	Yes	20/20 with gl.	Yearly	?	Yes
Whittleage, G. A.	Yes	Yes	20/60	6 mos.	Very small	Yes
Wilbur, E. P.	Yes	Yes	20/200	6 mos. to 1 yr.	Very small	Yes
Whitney, Geo. W.	Yes	Yes	20/40	6 mos.	1 in 10,000	Yes
Willeys, Jos. E.	Yes	Yes, about 3 D.	See Remarks	6 to 8 mos.	Very small	Yes
Wilkinson, Oscar	Yes	Yes	6/12 and 6/18	6 mos.	1/10 of 1%	Yes
Williams, Chas. H.	See Remarks					
Wilmer, W. H.	Yes	Yes	20/200	Yearly	Small	Yes
Wilson, Norton L.	Yes	No		6 mos.	1/4 of 1%	Yes
Wishart, C. A.	Yes	Yes	20/40	6 mos.		Yes
Wood, Casey A.	Yes	Yes	20/200	Yearly	Rare	Yes
Woods, Hiram	Yes	Yes	See Remarks	See Remarks	Small	Yes
Woodruff, Thos. A.	Yes	Yes	20/100	6 mos.	—1%	Yes
Woodruff, H. W.	Yes	Yes	6/60	Yearly	Very few	Yes
Worth, Claud	Yes	Yes	See Remarks	See Remarks	Very few	Yes
Wright, J. W.	Yes	Yes	20/30	Yearly	Very small	Yes
Wurdemann, H. V.	Yes	Yes	20/80 each eye	Yearly	—1%	Yes
Young, H. B.	Probably	Yes	20/40 - 20/50	6 mos. and after 3 in 5 yrs. layoff		In most instances
Zentmayer, W.	Yes				Rare	Yes
Zimmermann, M. W.	Yes	Yes	?	Yearly	—1%	Yes

Question VI.

Remarks.

Remarks

Yes, with the opinion I have expressed, not with yours. Cannot see that it would effect the discussion, as engineers and firemen would be more likely to have glasses broken than people following less strenuous vocations.

I do not believe that we should promote a fireman to a position of an engineer who requires glasses to give him the above acuteness of vision. An engineer who has been in service five years as an engineer should be allowed to continue in service with glasses which give him 20/20 in one eye and 20/30 in the other provided he has at least 20/50 in each eye without glasses. I feel that all trainmen wearing gl. should be examined at least once a year, and if the vision has fallen since the glasses were prescribed, they should be referred to the Company oculist for re-testing.

I require 20/20 for men entering the service, but men that have been in service for a long time 20/40 is all that I require of them. I find a man with 20/40 at night sees infinitely better without glasses than with them, even if the glasses give him 20/20, at least that is my own experience; even with 20/60 he sees somewhat better without glasses at night than he does with a glass that gives him 20/20. I certainly agree with you that an old engineman of several years experience should never lose his position because he requires glasses to restore the normal standard. I find that a man with sharp 20/30 for distance can for all intents and purposes read signals well enough not to run any risks. I think it is a hardship that he should be kept out of promotion for a small defect of this kind. Referring to the matter of a person with 20/40 or 20/60 vision seeing better without glasses at night than in the day, you ask me for an explanation. I cannot give you any. I have been puzzled over the thing for a long time and cannot understand it. First, to start with myself, I have a vision in the right eye of 20/60, in the left of 20/40, simply hyperopia, all of which I have developed since I was 45 yrs. of age, prior to that it was latent. My glasses give me 20/10. Now at night out of doors I see better without my glasses, the darker the place, the better I see without them; where there is bright electric light I see better with the glasses. I read your note last evening, and in walking up town some distance, I took particular pains to test my glasses, and except in the brightly illuminated places, I saw much better without them. Several blocks off I noticed there were some red and white lights to show some street repairs that were going on. My glasses enabled me to see these lights more sharply defined in outline, but no better. Without the glasses they were stellate in appearance. I don't know whether this has any dependence on the pupillary action with or without glasses on. I have investigated it closely and have no theory to advance. At the same time, it is a matter for consideration for enginemen on the railroad.

The minimum diminishment of vision must be that which may be corrected by a lens that does not distort at periphery.

In a statement I sent to the Committee on Safety Appliances of the Amer. Ry. Ass'n last August, the following statement was included. "When on re-examination of employees in class A or B it is found that the acuteness of vision is below the required standard, but can be improved by the use of glasses, sufficiently to enable them to pass, the Company will, at its discretion, on the recommendation of the examining surgeon, and giving due consideration to their service record, etc., allow such old employees to pass the test for such class, provided such defect in vision is not the result of disease of the eye with progressive failure of sight, and such employee must use his glasses while on duty and carry with him an additional pair to use in case of accident. Glasses are allowed in any class for reading test." This is almost the same wording as the rule I drew up for the Interborough Rapid Transit Co. of New York about a year ago, and which has worked well there. The classes A and B, above referred to, include enginemen, firemen, train and yardmen, in fact, all employees where the requirements call for a test of vision without glasses in the original test. It seems to me that a yearly re-examination of such men would be sufficient.

Not less than 20/30-40. These men are very apt to leave off their glasses, and they should possess fair vision without them. It should, I think, depend upon the nature of work, age, nature of ametropia, etc. Yearly examinations would seem the safest.

He should, I think, be able in the event of the glasses being lost, by the exercise of special caution, to safely discharge his duties to the end of the run without them. (4) This should depend upon the nature of the defect. The surgeon who sees the case should decide date of next examination.

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DISCUSSION.

DR. SHERMAN VOORHEES (Elmira, N. Y.): The paper is of great interest to all of us, not only to the traveling public but to a large class of men, many of whom are our patients. I think the method as practiced of examining the railway applicants as enginemen, firemen, etc., is very faulty. I examine a great many for railway service, and after the examination by the train master I find many accepted with $20/40$ vision in one eye. Most officials are not careful of the examination of applicants, and so I am in accord with what Dr. Black has said, that these examinations should be made by trained oculists and that all applicants should be examined under a mydriatic, and if they are found to have latent strain then that applicant should be rejected. That does away with this question almost entirely, because the older men will not develop it later. I think patients with normal accommodation all say they can see better at night without lenses on than with. I think it would be an injustice to the men long in the service to say their services would be no longer required because of a vision of $20/40$ in one or both eyes. These men are, in my opinion, safe employees. They know all the road, they have been in the service long, and if the vision is brought up to normal in each eye with glasses, they are safe men. I believe they are not safe employees if the vision falls below $20/40$ or $20/50$, and the safety of the public demands they should not continue in the service. I know a large number of engineers leave off their glasses that know they see better with them on. I know men who take them off in the yard because they do not want to be seen wearing glasses, but after they get out of the yard they put them on because they can see better. I think the idea of amber glasses is good on bright days, but I do not think they would be of service at night. I appreciate Dr. Black's paper very much.

DR. W. R. PARKER (Detroit): I represented the Michigan Central last winter at a meeting held in New York, to which the roads of the New York lines sent oculists and general superintendents. The object of the meeting was to determine the vision standard and hearing for all employees, also methods of examination for color sense. We had great difficulty in determining the minimum vision an applicant

should have, without glasses, and still be retained in the service, if glasses give normal vision. That question provoked an animated discussion and was the most difficult thing we had to settle. The opinions differed from $\frac{20}{200}$ to $\frac{20}{30}$, but it was finally determined that the minimum vision could not be less than $\frac{30}{40}$ combined, or less than $\frac{20}{50}$ for either eye. The next question that came up was what to do with the men who had $\frac{20}{20}$ vision at the age of 20, who when they reach the age of 50 will have not more than $\frac{20}{200}$, certainly less than $\frac{20}{50}$. It was determined as a practical test, to eliminate all applicants who in the examination not only failed to reach $\frac{20}{20}$, but those who did reach $\frac{20}{20}$ with a plus 1.50 lens. That eliminates the large percentage of latent hyperopias. Since then we have examined 5,000 to 6,000 employees and several hundred applicants. Of the latter, about four per cent. were rejected because able to read the $\frac{20}{20}$ line with the plus 1.50 lens. These four per cent. are rejected now instead of after being in the service 20 or 30 years, when the vision would go below the required standard because of presbyopia. The original examination was done by oculists. They decided that that was too expensive, and some other scheme would have to be devised. I was given six assistants who were clerks in the office. If tests must be done by others than those specially trained, it seems to me this is a very practical solution. Since that time I have ridden on engines, not as far as Dr. Black, but about 1200 miles. Too much cannot be said for the amber glasses. I have tried them time and time again, by letting experienced firemen who do not have scotoma put them on, and asked them at the end of the run how they liked them, and they say, "I think they are all right; I can see just as good with them as without them." I think that was a good, practical answer, as the work about the engine was not interfered with. The amber glass will not prevent the scotoma entirely, in one unaccustomed to firing, but enough so that vision is not interfered with. It is undoubted that most cases of hyperopias do not see as well at night with the glasses. The reflection of the light that Dr. Black speaks of being the cause, is new to me.

Dr. Black has done much to develop this work, and his papers were often quoted at our meeting in New York.

DR. H. V. WÜRDEMAN (Milwaukee): Can you get enough safe young men with inclinations toward railroading, who have emmetropic, standard or normal eyes, who will not, when they are 40 or 50, be obliged to wear glasses in order to see distinctly at a distance? No, you cannot. Only about ten per cent. of people have nearly normal or standard vision. If a slightly ametropic man 40 or 50 years of age loses his glasses, if he has fair vision, he is probably not incapacitated to run his train, because most men have more than $\frac{15}{200}$ vision. That is the lowest standard without glasses, because in the best kind of skilled labor we can do our work well when we have only $\frac{1}{2}$ standard vision. We can do some work if our vision falls no less than $\frac{15}{200}$. The commonest kind of labor requires only 5 to 25 per cent. of the standard acuity. Amber glasses at night fall in the same category as glasses for refraction. The night is worse with the amber glass than without.

DR. FREDERICK H. MILLENER (Buffalo, N. Y.): I have heard Dr. Black's very able paper with great pleasure, and I wish to add a thought in reference to the different values of lenses. Nature has provided the human eye and the eye of animals with lenses which freely permit all the rays of light to pass through, from the red end of the spectrum to the ultra violet end. Nature has also formed certain crystals, notably the quartz crystal, which also permits of the passage of the rays of light. Not so with the crown glass lenses of commerce, which very materially obstruct certain of the rays, specifically those at the violet end of the spectrum, and the ultra violet rays. So that it is not strange that with the crown glass lenses thus obstructing a material percentage of the rays one cannot see as clearly or as well as with the quartz crystal lenses. The crown glass lenses do not entirely obstruct the rays, but they do remove the ultra violet ray, which ray is responsible for the tanning which the body receives in sunshine—in other words, it is the chemical or bacteriocidal ray. Another point which I wish to make is, that the quartz crystal lenses do not steam or fog as readily as crown glass lenses do. I have experimented with both lenses of equal power, on a locomotive and in a machine shop, and found that the quartz crystal lenses afforded a far better medium for vision.

I was also greatly interested in the slides presented yesterday by Dr. Casey Wood and his paper on the Fundus of the Mammalian Eye. Perhaps it was not generally noticed that in the eye of all night prowling animals the fundus disclosed very strongly the red, orange and yellow colors, while in the day prowling animals the fundus was of the blue indigo and violet colors. I simply call attention to this fact, and would be glad to hear some one explain the reason for it. It may be due to the lenses, it may be due to the fundus. In any event it is a curious and noticeable distinction.

DR. ALLEMAN (Brooklyn): My theoretical opinion was that the men who did not require glasses were the better engineers, but after my first ride on an engine I was converted. An engineer called my attention to the clouding of the glass in the engine cab. It frequently happened in a storm, and he had to stick his head out of the cab to see, and he carried a pair of goggles for protection. If a cinder strikes the eye, the intense pain disables the engineer just at the moment he wants most to see. The glasses can be protected from clouding from change of temperature by a chemical preparation. Another point, which I think has not been mentioned in this discussion, is the case of a man with perfect vision and lack of muscular balance, such a defect could be responsible for impaired judgment. He could not be competent in an emergency; he would be in a condition of nervous exhaustion that would render instantaneous accommodation impossible. Nothing brings out the symptoms of muscular defects as much as watching moving objects. I cannot look out of a car window for two hours without giddiness, dizziness and discomfort, and we should consider the muscular relation in an examination of engineers.

DR. JACKSON (Denver): I agree with Dr. Würdemann that we can not get enough men who are emmetropic to fill these positions. But even if we could, these men being emmetropic at 20, at 40 or 50 a large proportion will have become hypermetropic and require convex lenses to give them normal vision. The unfavorable effect of the lens at night has been alluded to. The most important cause of this, I think, has not been explained. More than 20 years ago when I commenced to wear lenses my attention was turned to this

impairment of vision by lenses in a dim light, and I have carefully studied it since. The reflection of part of the light has something to do with it, but the dilatation of the pupil is more important. Accurate vision is gotten through the center of the pupil. The large majority of dilated pupils show the margin comparatively myopic. This margin admits much more light than does the central area which gives accurate vision, and for the marginal region the convex lens is a hindrance rather than a help. The difficulty diminishes as the pupil grow smaller with age. Blurring of vision by dim light in people who do not wear glasses might often be lessened by putting on concave lenses. As a practical objection to the wearing of glasses, this should be thrown out. It does not interfere more with the vision of those wearing glasses than those without.

DR. E. B. HECKEL (Pittsburg): I am surprised that the amber glass has not been used more commonly than it has. Sportsmen have been using it for years in shooting contests. These amber glasses are sold in the shops under the name of hunting glasses. The question of seeing better in the dark without lenses is one that has been asked me thousands of times, and I have been in the habit of explaining it to my patients in the following way: The more intense the light is, the more necessary is it for the image to be perfect; we unconsciously demand this. In the dark with a moderately dilated pupil the image is not so distinct, and we unconsciously make an effort to accommodate, which results in an image less distinct and as a rule the removal of the glasses, when the eye is able to produce a more distinct image and results in better vision without glasses. The acetyline and electric head-lights have been referred to. I have made a number of inquiries among enginemen and find that they condemn them. I also have found that enginemen who make very fast runs, prefer to run at night with an ordinary head-light, as they claim they can see more.

DR. RYERSON (Toronto): With reference to the use of glasses by railway men, my experience has been that often they object to the use of them about the yards, but put them on when out of sight and acknowledge they see much better with them. Experience with amber glass is that it increases acuity of vision nearly 30 per cent.

DR. VALK (New York): I want to bring the matter down into rather a practical point, in regard to the present and future. In the first place, as I understand from our railway examiners, you have got to do something in regard to the men now employed. We do not want to throw these men out because they have 1 or 2 D. of hypermetropia. I agree with Dr. Black that these men should be allowed to wear glasses. What is going to be done with men who go into the profession of railroad engineering? A large number of men have 1 D., but they will go through life very easily to 50 or 60 with that degree of hyperopia. My own refraction is about the same and yet I do not use glasses. But for men going into engineering in the future, if they have more than 1 D., stop them at once, but if they have less than 1 D., when they get older they will be perfectly safe.

DR. YOUNG (Burlington): I am the original investigator of this subject, and I believe this has all come out in a report I made before the Chicago Ophthalmologic Society some two years ago and published in the *Annals*. All the points discussed here were in that paper (*Annals*, January, 1904), with the exception of the amber glass. I do not think the question of the wearing of glasses by railroad men is as important as the present discussion would lead us to suppose. Any one who will ride in a cab for 100 miles will find that the protection of the eyes is a serious question, but with railroad men you will have to overcome a great deal of prejudice against men wearing glasses on railway engines, not for their inherent defects, but for the popular feeling against it. You will find there will be a greater disposition on the part of railroad men to reduce the standard of visual acuity for the occupation. Investigation made on the Burlington four years ago demonstrated to me that a man with $\frac{20}{40}$ or $\frac{20}{50}$ was capable of seeing any signals at a safe distance. These fast trains have emergency stop-breaks that will stop a 60 miles an hour train in eight or twelve hundred feet. That is less than a quarter of a mile; and semaphores are on a scale of $\frac{20}{20}$ at one half mile. In making these observations I have had the advantage over other men who have made them, in that I had the age and was therefore in the class of the enginemen. So far as wearing glasses is concerned, I had the

same difficulty with my lenses at night, but since I have passed the limit of age, that difficulty has disappeared and I no longer take my glasses off at night but see with them better. In reducing I used the concave glass as Dr. Jackson has suggested, and thus produced my accommodation. But if you will make your standard not $20/20$ but $20/40$ or $20/50$, it will not be so important a matter.

DR. LUCIEN HOWE (Buffalo): No matter what standard we have, the American Association of Railways is going to do just what it chooses. They asked me for suggestions and I advised a standard as high as possible, but they promptly turned it down. It is perfectly useless to make our theoretical standards and to expect them to conform to them. The only way is to make one comparatively low and then later improve it.

DR. D. T. VAIL (Cincinnati): It is useless and folly for officials to formulate any definite rules for engineers to follow, regarding the wearing of glasses. They will put them on, if required, until they are out of the yards, and then they will take them off if they choose. If the glasses become fogged, they will remove them, no matter what the rules are, and if they can do better with amber glasses they will wear them. They must accept the moral responsibilities of the run and can do better if they have the privilege of doing as they please in the cab; this they will any way.

MR. WM. TUNKE (by invitation): I am an engineer on the Lake Shore road. The invitation was extended to the Chairman of the Board of Adjusters, but he could not be here. I came up and listened on invitation. I have run an engine several years. I wear glasses in order to read by. I have always stood $20/20$, but may have to go and see Dr. Hubbell yet. I thank you for the kindness of allowing us to attend this convention of this association. Engineers are in a little different class as to sight. They are men that would be called ordinary good in sight, but they can see more than good sight at times. That is, put them there in the cab and they can see more than all you people with your glasses. I am not going to talk here on eyesight. In regard to your seeing better at night: I have been constantly on an engine—if I live two months longer, 46 years in one company, [Applause]

and I might throw a little light for those people that want to know the reason. You say to see a semaphore one mile in day time is doing well, but at night there is no semaphore to see and you see the light. And where you can see a semaphore a mile in the day time, in the same place you can see the next one two miles. It is the absence of the light that gives you the benefit of the white or red light. We have our caution signal and the danger signal. Approaching these signals, if both are down we have a clear track for two miles, if the signals are working. If the yellow is up and the other down, we have a clear track for a mile. We must go prepared to stop before we pass the other block, but it is clear to that block.

Another thing is the breaking of glasses. I do not want to tell my own experience, but once going 50 miles an hour and passing another train I felt something hit me. I went over against the back board, and the fireman did not see it. I was blind. I reached the break-handle and I shouted to him, "Look out! she's stopped;" and he looked to see what it was, and it was a bunch of grapes some tramp had thrown at me. If a man is blinded for a moment there is always relief right there. It is always within reach, and he can do it with his eyes gone, and he has a fireman that is supposed to have good sight—he can call him. I am getting along in years and do not expect to last much longer, but I would like to finish up my 50 years.

Dr. Vail: I think we will all be willing to trust ourselves in your hands a while longer.

MR. A. HOFFMAN (by invitation): I am a Lake Shore passenger engineer. You see a light at night further than in the day time. The semaphores are three feet long. They always have a background, but at night you do not see the background, just the light, and that is the reason you can see it further than in the day time. We have 250 signals between Cleveland and Buffalo, and it keeps a man guessing on these fast runs. Dr. Black came up this morning with me. We have 3:55 to make the 153 miles. When I see a semaphore at a mile, there is lots of time to calculate whether I have to go slow. I have been 26 years running an engine and 33 years firing and engineering, and I may be turned down for

my sight pretty soon. I can see just as far as any one, and I guess could pick them out on the road, and know every inch of the way, and know where every siding and signal is located. But of course the sight question is bound to knock us out.

DR. J. E. COLBURN (Chicago): Some years ago I was on the plains hunting. I had $\frac{20}{20}$ vision; I have trained myself for a number of years to observe things carefully, being something of an amateur artist. I was with a man who had lived in that country, and he pointed at considerable distance and said, "There is a wolf climbing along that bluff," and he located it by a shrub at one point and another patch below it. I looked at it carefully and could absolutely see nothing. He fired his gun and the wolf jumped, and I could see it. He came into my office during the following year and his vision was less than $\frac{20}{40}$, had a compound hypermetropic astigmatism. It was the training that he had that made his sight accurate and enabled him to estimate what he saw, and that is what makes the old engineer's sight valuable to the road.

DR. BLACK (closing discussion of his paper): With reference to Dr. Parker's suggestion that when men come up for examination with hypermetropia of 1 or 2 D. to turn them down, it would, I think, in the end tend to give us engineers who would not need glasses for distance in later life; but, as Dr. Snyder has pointed out and as Dr. Würdemann and Dr. Jackson have said, it is utterly impossible to get enough men to supply these positions on railroads without 1 or 2 degrees of latent hypermetropia. Regarding scotoma and the amber glasses, while there is a slight one from looking directly into the fire-box with amber glasses on, it is reduced so much that it does not interfere with the seeing of the signals at night. I gave the opinion that with $\frac{20}{100}$ vision in one eye and even below that in the other, if vision of both could be brought to normal with glasses, the man could be considered safe for an engineman. It would probably be safer to say not less than $\frac{20}{50}$ in one eye, because with this amount of vision in one eye he can finish out his run to the end if deprived of his glasses. Too much cannot be said in favor of the protecting glass. Ninety-five per cent. of the men carry these glasses for all

sorts of emergencies. The question of monocular diplopia was referred to by Dr. Duane. Regarding reflection of light by the lenses causing hyperopes not to see so well with their glasses at night, if you will take two lights of equal photometric value and place before one of them a white crystal lens you will find with a photometer a large reduction of the original source of illumination that goes through this white lens, that is, a considerable amount of light is reflected and absorbed in passing through this glass. At night the small amount of illumination objects have is very much effected by the reflection of the lenses and is so diminished; but the night signals are self luminant, and the diminished vision with glasses at night will make no difference in seeing them. As to enginemen wearing a glass surreptitiously, I have seen it time and time again, and they say they feel safer.

Mr. Tunke, who spoke to us a moment ago, was the engineman who really made the record run from Chicago to Buffalo for the World's Record. When he took the train at Erie they were behind the record, but he brought it in ahead of time with an inferior engine.

FIXATION OF THE EXTERNAL RECTUS MUSCLE IN NYSTAGMUS AND PARALYSIS.*

By J. ELLIOTT COLBURN, M.D.

CHICAGO, ILL.

A RECENT abstractor of my former article on fixation of the external rectus observed that I was going counter to the teaching of ophthalmology in employing fixation as a means of improving vision in nystagmus. The following note will explain my position:

Nystagmus of congenital origin, not due to atypic development of the brain, may be improved, in some cases, by the correction of an error of refraction and the addition of sufficient plus strength to allow of excessive convergence. When the error amounts to an exotropia, a strong plus glass before the fixing eye, and that eye strongly abducted, allows of

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clearer vision with a minimum amount of oscillation. Noyes has reported good results from complete tenotomy of internal recti. In most of the congenital or idiopathic cases which have come under my observation, the position of greatest rest was that of marked abduction of the fixing eye, whether the refraction was plus or minus, and the effort to see most accurately was always made in that position. Whatever may have been the refraction, the object to be seen was held as closely to the eye as possible, apparently with the purpose of diminishing the excursion of the image upon the retinal field. Nystagmus has disappeared in patients suffering from a high degree of error of refraction after wearing a full correction, even though in some cases the visual acuity remained far below the normal. The above, together with observations made by Snell, Oglesby, Noyes, Stevens and others, would seem to contradict the theory of Van Arlt, that the object of the more or less rapid movement of the eyes, or eyes and head, was an effort to bring a greater number of percipient elements into the field.

In the *Ophthalmic Record* of August, 1904, in a paper entitled "Partial Fixation of the Globe for the Improvement of Vision in Certain Cases of Nystagmus," I reported a procedure which seemed to promise some improvement in vision of patients suffering from nystagmus who are not relieved by other means. The operation consisted in fixing the external rectus muscle to the temporal wall of the orbit. The following is the method which was used: After complete cocaine anæsthesia the eye was placed in a central position by an assistant and a small wound made in the conjunctiva at the temporal cul-de-sac for the purpose of marking its position. The eye was then rotated inward, the conjunctival cut enlarged and the muscle exposed. The external orbital-muscular check are freely excised and the periostium wounded. A doubly-armed suture was passed through the muscle, then deep into the periostium and out into the conjunctival sac and tied. I have now modified the operation by carrying the suture out through the integument and tying over a plate tin button.

I have found the needle which I had made by F. A. Hardy & Co. of great service in placing the suture in the

muscle. The suture can be then threaded into a strong curved needle and with a properly constructed needle holder passed out and through the integument.

The first case of the last series was one of lowered vision due to ophthalmia neonatorum. Miss M., aged 18 years, had ophthalmia soon after birth. Vision— $R=\frac{4}{200}$. Not improved by glasses. L=light. Right eye—very slight oscillating nystagmus. Point of greatest rest—eye converging to 30 degrees. Left eye—turned 30 degrees outward and upward, exposing only a small portion of the cornea below a drooping lid. When the eye was brought as near to the median line as possible there was violent nystagmus. Relief was sought to correct the unpleasant effect of the outward and upward rotation of the left eye. The first step was the fixation of the left external rectus, and four weeks later an advancement of the internus was made. The result was almost perfect quiet in the median line. The right internus was tenotomized and held in position by the fixation suture, securing straight-a-head fixation. The cosmetic effect was all that could be desired, and the improvement of vision= $\frac{20}{100}$.

Dr. Casey Wood suggested at the time that I made my first report that fixation of the recti muscles might be of use in selected cases of paralysis of the recti muscles. The following case—Mr. L., aged 24 years, complete paralysis of the right internus following an injury—seemed to offer a good opportunity to make the trial. Vision— $R=\frac{2}{100}$. Not improved by glasses. L=normal. The right cornea was partially concealed in the drooping lid and held well in the external canthus. The right externus was fixed, and the internus, with the capsule, advanced about four weeks later. The position at this time—eight months after the operation—is, when at rest, 5 mm. to the nasal side of the normal, with 10 mm. rotation.

In the third case, Mrs. L., aged 42, paralysis of the third nerve, and lowered vision in the left eye following an injury to the head seven years prior to the first visit. The eyes were completely rotated into the external canthus with 2 or 3 mm. of converging motion, the head always tilted forward and turned away from the object viewed. Fixation and advancements were made, resulting in the slight convergence of both

eyes and 5 mm. to 10 mm. lateral range of motion of the right eye.

My limited experience with the operation for the improvement of vision in case of nystagmus leads me to consider it favorably. The cosmetic effect in suitable cases is all that can be desired. In paralysis of the ocular muscles or any set of them, it is certainly more desirable than the operation for exsection, and more satisfactory than the advancement of the paralyzed muscle without the fixation.

THE SUBSTITUTION OF ADVANCEMENT FOR TENOTOMY IN THE SURGICAL TREATMENT OF DEVIATIONS OF THE RECTI.*

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IN hardly any other field of ophthalmology have we so much to learn as in the treatment of deviations and abnormalities of the external eye muscles. It is not improbable that we are to-day approaching the solution of the problem with a more rational adjustment of remedy to cause.

It seems almost inconceivable that from the day of Diffenbach in 1839 till to-day the object of all or most all operators has been to make a pathological condition the standard; in other words, when it had been found necessary to bring about a degree of parallism, the course was to make an otherwise healthy muscle equal the faulty one, thus substituting two weak muscles (more or less equal in strength) for one weak and one relatively strong. It would seem that the more rational way would be to attempt to bring about such a condition that one would have two equally strong (healthy) muscles. To bring about the first mentioned effect tenotomies are done, for the latter, advancement.

In order to properly estimate this assertion, you will pardon my calling your attention for a moment to the anatomical and physiological factors in the motor apparatus of the eyes. The external eye muscles are so placed and enervated that they hold the globe in certain position and revolve it

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about a pretty constant point. Their functions must be carried out with mathematical exactitude, for it concerns not merely the motion of one eye, but rather the synchronus action of both upon the same point which the individual wishes to see clearly. Even in the position of rest, muscular activity is necessary; these actions work in various (antagonistic) directions. We see thus how the four recti, whose function it is in synchronus action to withdraw the globe into the orbit, are checked by the action of the oblique muscles, whose action is to pull it forward. In the same manner, rolling of the eye (turning about the sagittal axis) in one direction is controlled or held in check by opposing muscles.

If the globe change its direction by the action of one set of muscles, at once the antagonist or opposite set are called into play; not to hinder the first set, but to make their action more exact, to prevent them taking the eyes too far in a given direction and to keep the eyes steady in their new position. We must constantly bear in mind that while we are awake the eye muscles are in more or less tonic contraction. The correctness of this observation is seen when one muscle loses its activity, i. e., in paralysis, when at once its antagonist is brought into full play. Had binocular vision been present before, at once diplopia comes to light. The false image then takes the direction to which the paralyzed muscle would have taken the eye under normal conditions. The diplopia, as well as the false projection, increases in the sphere of the paralyzed muscle. The working of tenotomy—that is, loosening of a muscle from its insertion on the globe—is precisely the same in fact as paralysis. If the operation is done so gradually that the muscle takes up its new position not far from its normal insertion, there results a slight insufficiency, equal to a mild paretic condition. On the other hand, has a tenotomy in the ordinary acceptance of the term been done, then we have all the symptoms which characterize a paralysis.

When a tenotomy is performed upon a rectus, the eye is pushed forward out of the orbit, just as in paralysis of such a muscle; for then the muscles mainly concerned in pulling the eye forward are the gainers in equilibrium. The excursion in the direction of the retracted muscle is decreased; in

the like direction false projection, and if binocular vision had existed diplopia ensues, depending in degree upon the weakening produced by the operation.

The retro-emplacement (by tenotomy) in a case of paralysis of one muscle—the rectus externus for example—when done upon its antagonist (the internus) differs in one respect in its effect from the enervation paralysis. If an eye is strongly everted, in a case of paralysis of the internus, and the externus is tenotomized, then the retro-emplacement of the externus is not very marked, just because the contractility of the internus is decreased. The decrease in excursion, the false projection, and the diplopia in its direction, remain. We have added now the paralysis of the externus, to one of the internus. By the tenotomy of one of the horizontal acting muscles, the symmetrical action (convergence or divergence) is without question decreased.

When binocular vision is present, tenotomy of an internus produces an insufficiency of convergence, which by reason of the crossed diplopia renders near work impossible. It is true, one concerns one's self little about the amplitude of convergence in concomitant squint, because binocular vision does not usually exist, and we have made little attempt to awaken this function. But in a true conception of our ability to cure squint, we should attempt not only to bring about what Landolt calls a "photographic cure," but also binocular fixation and the fullest approach to normal amplitude of range. This range is 30 degrees of the arc for both the externus and the internus.

When tenotomy is done upon muscles whose action is not so simple as the internus or externus—on the superior or inferior recti, whose action is more or less aided by the oblique, the result is the same—a paretic motion. Its consequences are, however, less.

This view of the result of tenotomy—credit for which is mainly to be given to Landolt—is at variance with the commonly accepted one. As a matter of fact we have been accustomed to thinking that tenotomy decreases the excursion of the eye in the direction of the retro-emplaced muscle, and that only for the excess which the strabismus brought out. Beyond this we gain for the not operated (antagonist) muscle

as much function as was lost upon the tenotomized muscle. Actual trial of the excursion, convergence, the projection, and binocular vision before and after operation, prove the contrary. The retraction of the tenotomized muscle, the contraction of its antagonist and pushing forward of the globe cause the tenotomized muscle to be attached very much farther back than just so far as the contraction of the antagonist would carry it. This is contrary to the theory of action held heretofore.

The influence of the tenotomy upon symmetrical movements of the eyes must not lead us astray. We all know cases in which the external rectus has been severed for insufficiency of convergence, where a true convergent strabismus has resulted. And that the danger of converting a convergent strabismus into a divergent one with subsequent loss of vision, protrusion of the globe and loss of convergence, is an all too common experience to require further words.

The action of advancement is directly the opposite of paralysis and of tenotomy. Advancement consists in bringing the attachment of a muscle nearer the cornea. Thanks to this procedure, the power of the muscle upon motion of the eye is increased. There are two methods of producing this effect: either cutting the tendon free and re-attaching close to the cornea with the aid of sutures, or by some tucking operation. This latter seems to give a good deal of satisfaction at the hands of many. It may be characterized as the bloodless, while the former is the bloody operation. In case of advancement it has been maintained that the antagonist has lost considerably in mobility. It is believed that such observation is not the result of actual trial.

Why should the influence of the internus be decreased by the advancement of the externus? We do not interfere with the internus. The activity of the internus is not passive, but active, that is when it is called into action as antagonist of the internus. If one wishes to turn one's eye to the right, the enervation impulse to make the left eye do this is sent, not to the externus (which turns the eye out), but to the internus.

These simple statements are fully sustained by actual trial. The excursion of the eye in the direction of the ad-

vanced muscle remains intact. If any change occur, it is rather an increase of action for both; and this is because the eye is pushed further back in the socket and the antagonist muscle has gained in tone and range of action.

Given a case of convergent squint, the amplitude of range of all the recti will usually be found short of the normal. Advancement of both externi will show not only an increase of power for externi, but the interni as well.

It is indeed strange that errors of the scope of advancement operations should become current, and it is usually explained upon the ground that unfounded theories rather than firm facts are most readily accepted, especially when it is necessary to confirm the latter. It seems that many think of the muscles as firm bands between which the globe is fastened; while we know they are really contractile organs.

There are four methods of securing an advancement, viz: simple advancement to the cornea, tucking, advancement together with shortening and resection with re-attachment of the shortened muscle at its old site. The two latter are done when heightened effect is sought. The advantage of the last named (re-attachment at the old site) lies in the claim that we thus run no chance of altering the vertical position, that is to say, that we do not elevate or depress the horizontal meridian. The disadvantage lies in the fact that we get less effect thus than by simple advancement, and that it is better if shortening is needed to sacrifice the tendon rather than the contractile muscle. By careful operation, the danger of altering the horizontal meridia is practically nil. If shortening has not been too radical, the influence on this muscle is a gain as far as its excursion is concerned, and certainly no disadvantage to the antagonizing muscle.

Look at the eye muscles in the cadaver. Most of us are astonished when we see these long, relaxed, vermiform structures and recognize them as the eye muscles. Now how much may we shorten these before they, despite their tone, would influence the rotation of the globe in the opposite direction? Only when so large a piece has been sacrificed that the eye is held fast even in its relaxed state. This may only be permitted in an absolute paralysis of the muscle, and in this case the result is a decided improvement upon the pre-

existing one. At least, the operation brings the binocular field of fixation directly before the patient and at the same time corrects the deformity perfectly.

Advancement (simple or in combination with resection) is indicated in all forms of paretic muscle disturbances. And of this there can be no doubt. It is also indicated in concomitant squint and in insufficiency. In paralytic conditions the greater the effect desired, naturally, the larger the portion of excised tissue will be. Should the result not be sufficient in a given case, we augment it, not by tenotomizing the antagonizing muscle, but by advancing the corresponding one on the other eye.

As a rule, convergent squint is due to spasm of convergence, brought about by excessive accommodation due to hypermetropia—lack of static refraction—or to weakness of accommodation in cases where binocular vision is poorly developed (lack of dynamic refraction). As a rule, divergent strabismus (concomitant) is due to a relaxation or weakness of convergence. Therefore, strabismus convergent is an active, while the divergent form is a passive squint. But this is common to both forms, viz., that unlike paralysis, they concern both eyes. Therefore, in its correction, when operation is indicated at all, advancement should be done on *both eyes*.

An insufficiency consists in either lengthening out of the punctum proximum, or of a drawing in of the punctum remotum of convergence. The main symptom of which is diplopia, which becomes apparent much earlier than normal when the object of fixation is withdrawn or brought near.

The amplitude of convergence normally means a range of 10 meter angles positive and 1 meter negative convergence. It is necessary for continued application that we should have at least twice as much convergence power in reserve as the working distance calls for. If we hold that the working distance should be at $\frac{1}{2}$ m. (3 m. angles), then the reserve should be twice 3 m. angles, or 6, and the entire energy is represented by 3 plus 6, or 9 m. angles positive convergence. Not having this, one must either increase his working distance or use abducting prisms. These have distinct limits of practicability. It is found impracticable to use prism

stronger than would increase that convergence beyond 1 m. angle; over this, surgery must be our sheet anchor.

In the very nature of things, tenotomy is contra-indicated as increasing the already pre-existing insufficiency. To cure an insufficiency of convergence by a sacrifice of a portion of one's divergence, seems very poor reasoning. As a matter of fact, the tenotomy of the externi in such cases lead to convergent strabismus with homonomous diplopia in the distance, without correcting the insufficiency of convergence, i. e., the crossed diplopia for near vision.

For a fuller study of this question I would refer you to Landolt's classic article in Graefe-Samich (March 14, '05). Quite independently of this master, and indeed unaware that he was at work upon this subject, I have for some time been doing just what is here indicated and in such cases that were not readily corrected by prisms to do an advancement. It has, however, in the past nine or ten months been my practice to do an advancement for cases where formerly I should have tried to prop along with prisms. My results have more than justified my hopes.

Though I have long felt dissatisfied with prism treatment and tenotomy, graduated and att., it was not until I had gained the mastery of the advancement operation as practiced by Dr. Jno. E. Weeks that I felt I had the proper remedy at hand. In an article before the section of ophthalmology a year ago, describing this operation, I spoke of my intention to thus treat all strabismus cases *not amenable to non-surgical means*. I believe the reason above all that has kept most men from doing this, long ere this, has been the want of the proper technique and instrument to accomplish it. This want I feel has been filled by Weeks' instrument and operation.

From my present view-point, it seems to me that tenotomy of a rectus muscle should be reserved for those cases alone in which there is a low degree of insufficiency of convergence, in which at the same time there is a decided overplus of diverging power. I believe even here that we shall not do so for long. It seems also indicated in cases of vertical deviation not helped by 2 to 3 degrees of prismatic correction; when tenotomy should be done upon the higher

standing eye. When 4 degrees of deviation occurs, certainly whenever more than that amount of vertical displacement is present, advancement of the inferior rectus of the higher standing eye, or possibly dividing the effect on both eyes. Unfortunately, there seems to be, as yet, no means at hand of regulating the amount of advancement to be done.

Each case must be thoroughly studied from every side of the question. There is no place here for snap opinions or snap operations. Before undertaking an operation on the eye muscles, taking for granted that the refraction of each eye has been accurately corrected, the activity of each muscle should be studied for several weeks, and only after a most painstaking series of investigations can one offer a solution to the problem.

I do not believe over 6 degrees, or even that much, prismatic correction can be worn with comfort for a long time. It seems clear that lateral deviations under 4 or 5 degrees do not require operative interference, and yet there may be circumstances warranting it, even under such conditions. Just how much a muscle must be advanced can only be gauged by the effect desired to be produced. It is possibly better to over-correct than under-correct. Then if it be found necessary, one can lessen the effect, either by removing stitches early or loosening up the new adhesions till the desired result is obtained, as tested by the point of light and colored glass.

Landolt has lately devised a new operation—lengthening of the antagonizing muscle, the clue for which he has gotten from the orthopædic surgeons. The object is in given cases to assume that position of adhesion shall be exactly on the site of tendon's normal attachment.

Finally, I should like to reiterate the belief that in a very short time tenotomy of the rectus muscle will almost entirely give way to advancement operations.

PAMPHLETS RECEIVED.

Unilateral and Other Unusual Forms of Nystagmus.
By A. Duane, M.D.

La Influencia de las Diversas Clases de Escritura. By
M. N. Troncoso, M.D.

Herpes Zoster Ophthalmicus. By E. Stieren, M.D.

A Case of Acquired Cyst of the Conjunctiva Containing
an Embryonic Tooth-like Structure. By E. Stieren, M.D.

The World's Anatomists. By G. W. H. Kemper, M.D.

Excision of the Superior Cervical Ganglion in Inflammatory Glaucoma. By M. L. Foster, M.D.

Paralysis of Divergence. By A. Duane, M.D.

Some Unusual Fundus Conditions. By A. Duane, M.D.

Report of the Eye Department of the Hospital of the
University of Pennsylvania.

Extirpation of the Lacrimal Sac, with Cases. Microscopic examination of the excised sacs. By G. E. de Schweinitz, M.D.

36th Annual Report of the N. Y. Ophthalmic and Aural Institute.

A New and Physiologic Explanation of a Common Psychologic Phenomenon. By F. P. Lewis, M.D.